

# *Roadmap for Research Programs to Support the National Information Infrastructure*

	<i>Algorithms</i>	<i>Architectures</i>	<i>Tools</i>	<i>Networks</i>	<i>Languages</i>	<i>Applications</i>
<b>Collaborative Modeling</b> today's Grand Challenges	<ul style="list-style-type: none"> <li>physical models</li> <li>matrix methods</li> <li>spectral methods</li> <li>reactive flows</li> <li>molecular models</li> <li>electronic structure</li> <li>structural mechanics</li> <li>n-body methods</li> <li>optimization</li> </ul>	<ul style="list-style-type: none"> <li>workstations</li> <li>clusters</li> <li>single MPP</li> <li>vector computers</li> <li>simple distributed sys</li> <li>largely single domain</li> <li>strong on Flops</li> <li>weak on I/O</li> <li>small data systems</li> </ul>	<ul style="list-style-type: none"> <li>compilers</li> <li>debuggers</li> <li>auto parallel pre-X</li> <li>event tracing</li> <li>visualization</li> <li>algorithm prototyping</li> <li>libraries (MPI, p4)</li> <li>"tool kits"</li> <li>templates</li> </ul>	<ul style="list-style-type: none"> <li>ethernet (LANs)</li> <li>FDDI (LANs)</li> <li>HIPPI (sub-LANS)</li> <li>FCS (not yet)</li> <li>ATM (not yet)</li> <li>fiber infrastructure</li> <li>long haul T1/T3</li> <li>experimental OC-48</li> <li>workstation peers</li> </ul>	<ul style="list-style-type: none"> <li>Fortran 77</li> <li>C</li> <li>C++</li> <li>HPF (not yet)</li> <li>Fortran 90 (not yet)</li> <li>Fortran M (not yet)</li> <li>PCN</li> <li>Linda</li> <li>extensions vs new</li> </ul>	<ul style="list-style-type: none"> <li>extensions of vector codes</li> <li>physical models</li> <li>few non-science</li> <li>few engineering</li> <li>mostly modeling not design</li> <li>little linkage to exp</li> <li>batch still prime mode</li> </ul>
<b>Collaborative Analysis and Design</b> distributed shared resources	<ul style="list-style-type: none"> <li>caching, browsing</li> <li>MDA, MDO</li> <li>statistics</li> <li>comparative analysis</li> <li>interactions</li> <li>CAD linkage to models</li> <li>database linkage</li> <li>compression</li> <li>automatic filters</li> <li>neural networks</li> </ul>	<ul style="list-style-type: none"> <li>workstation aggregates</li> <li>MPP aggregates</li> <li>heterogeneous nodes</li> <li>cooperative systems</li> <li>mobile nodes</li> <li>database linkages</li> <li>multimedia support</li> <li>archival storage</li> <li>data systems</li> <li>I/O intensive</li> </ul>	<ul style="list-style-type: none"> <li>multiuser AVS</li> <li>multiuser MMA</li> <li>hetero MATLAB</li> <li>linkage CAD/MMA</li> <li>linkage CAD/MPP</li> <li>linkage CAD/DB</li> <li>linkage CAD/MDA</li> <li>multisite above</li> <li>penbased interfaces</li> </ul>	<ul style="list-style-type: none"> <li>gigabits to the desk</li> <li>national filesystem</li> <li>ATM combo</li> <li>nonmetered</li> <li>bandwidth on demand</li> <li>high peak / low mean</li> <li>aggregate for blasting</li> <li>standard HW/SW</li> <li>blasting protocol</li> </ul>	<ul style="list-style-type: none"> <li>integrated analysis and CAD languages</li> <li>MDO extensions</li> <li>hetero parallel</li> <li>fast MATLAB</li> <li>AVS like extensions</li> <li>OBJECT support</li> <li>implicit I/O support</li> <li>DB integration</li> <li>analysis objects</li> </ul>	<ul style="list-style-type: none"> <li>manufacturing of complex systems</li> <li>analysis of 3ary science problems</li> <li>rigorous analysis of computational exp</li> <li>simulation intensive engineering</li> </ul>
<b>Virtual Reality and Multimedia</b> multiviewer interactive distributed deployment	<ul style="list-style-type: none"> <li>projective geometry</li> <li>rendering</li> <li>kinematics</li> <li>linkage to physics</li> <li>new paradigms for visualization of data</li> <li>interactions</li> <li>compression</li> <li>indexing</li> <li>data movement</li> </ul>	<ul style="list-style-type: none"> <li>CAVE<sup>n</sup></li> <li>CAVE++</li> <li>HD-CAVE</li> <li>HD-Goggles</li> <li>body suit I/O</li> <li>retinal imagers</li> <li>3-D projection</li> <li>holographic display</li> <li>holographic input</li> <li>mobile links</li> </ul>	<ul style="list-style-type: none"> <li>3-D AVS</li> <li>3-D highend MMA</li> <li>multisite CAVE env</li> <li>3-D tcl scripting</li> <li>CAVE/ MOSAIC</li> <li>Goggleland</li> <li>connections</li> <li>linkages</li> <li>pad based kibitzing</li> <li>scalability</li> </ul>	<ul style="list-style-type: none"> <li>CAVE-to-CAVE</li> <li>low latency sync lines</li> <li>scaling up/down</li> <li>10's Gb each site</li> <li>fanin/fanout problem</li> <li>GB to each user</li> <li>mobile head to head</li> <li>LAN-MAN-WAN</li> </ul>	<ul style="list-style-type: none"> <li>3-D and VR extension</li> <li>VR objects</li> <li>parallel objects</li> <li>parallel interacting agents</li> <li>coupling to world DBs</li> <li>visual programming</li> <li>visual tuning</li> <li>pen based sketches</li> <li>3-D story boards/lang</li> </ul>	<ul style="list-style-type: none"> <li>medical imaging</li> <li>remote exploration</li> <li>database mining</li> <li>education</li> <li>telecollaborations</li> <li>3-D data immersion</li> <li>micro manufacturing</li> <li>entertainment</li> <li>travel reduction</li> </ul>
<b>Telepresence</b> remote manipulation and monitoring remote "participation"	<ul style="list-style-type: none"> <li>autonomous systems</li> <li>solids models</li> <li>planning, interactions</li> <li>navigation</li> <li>multimedia fusion</li> <li>sensor fusion</li> <li>human/computer int</li> <li>compression</li> <li>geometry reasoning</li> <li>vision and images</li> </ul>	<ul style="list-style-type: none"> <li>gigabits network</li> <li>hetero drivers</li> <li>MPP</li> <li>workstation</li> <li>realtime links</li> <li>multi-sensor</li> <li>robotic support</li> <li>manipulators</li> <li>nanobots</li> <li>mobile support</li> </ul>	<ul style="list-style-type: none"> <li>protocols</li> <li>sockets for multisense</li> <li>SVP simple video pro</li> <li>roboKIT interfaces</li> <li>stationary video interf</li> <li>voice/vid/window</li> <li>manipulator KIT</li> <li>multiview protocol</li> <li>DB interfaces</li> <li>agent interfaces</li> </ul>	<ul style="list-style-type: none"> <li>gigabits/human-rin</li> <li>short range radio</li> <li>transparent LB/radio</li> <li>digital video</li> <li>low latency ATM</li> <li>radio ATM interfaces</li> <li>multimedia mix</li> <li>multisense mix</li> <li>network compression</li> </ul>	<ul style="list-style-type: none"> <li>scripting for RINs</li> <li>manipulation scripts</li> <li>programming by example</li> <li>multisense objects</li> <li>multisense extensions</li> <li>linkage to multisense</li> <li>databases</li> <li>autologing of events</li> <li>autolog I/O library</li> </ul>	<ul style="list-style-type: none"> <li>monitoring r activities</li> <li>r manufacturing</li> <li>r assembly</li> <li>r exploration</li> <li>r experiment manip</li> <li>r inspections</li> <li>semi auto develop</li> <li>r piloting</li> <li>toys</li> </ul>